Constructed Wetlands as a Cost-Effective Practice for Pesticide Cleanup in Container Nurseries

Project Description: Container nurseries account for an increasing share of total nurseries in Middle Tennessee. The nursery industry is concentrated in middle Tennessee and ranks in the top ten agricultural industries in the state each year. Container nurseries traditionally apply large amounts of pesticides and nutrients to the nursery crops that are susceptible to runoff into surface waters. Irrigation water applied to container nurseries should be treated and recycled. Collection ponds have been used with some limited success. Pesticide or nutrient residues may concentrate in the ponds, since little if any treatment to remove harmful substances is used.

Constructed wetlands have not been evaluated for use in container nurseries. These wetlands have been successfully used by Tennessee Technology University's (TTU) Water Center to treat the town of Baxter's wastewater and have been operating successfully for several years. This site was ideal for incorporation of a container nursery to demonstrate constructed wetland treatments, since it was in place and operational. In this project, the use of constructed wetlands as a treatment, collection, and recycling process for irrigation and rainwater was demonstrated in a container nursery.

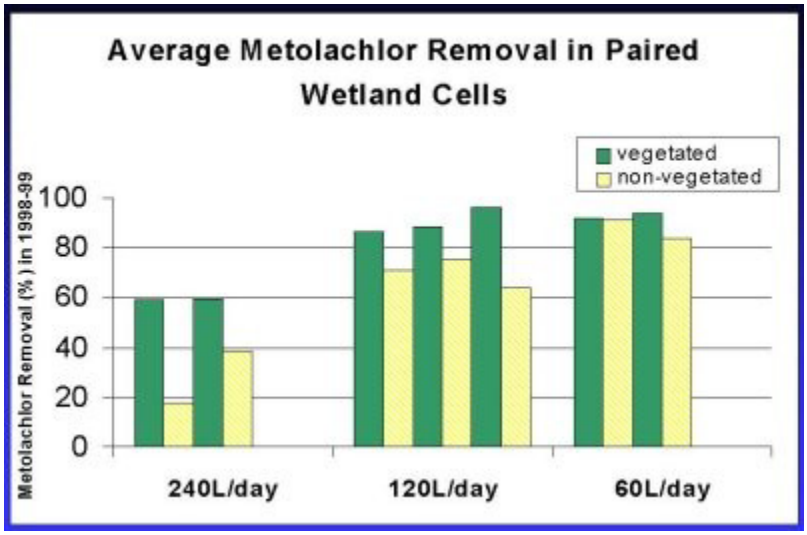

SF Constructed Wetland

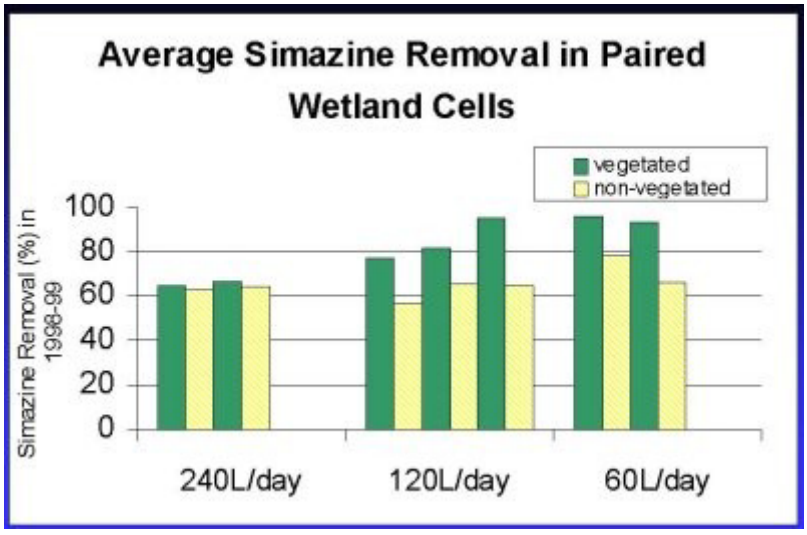
The primary goal of the project was the demonstration of constructed wetlands as a cost-effective best management practice (BMP) to reduce pesticide and nutrient runoff, and purify water in container nurseries. The specific objectives were to: (1) determine removal rates of simazine, metolachlor, nitrogen and phosphorus from container nursery runoff using constructed wetland cells; (2) determine the effect of vegetation (soft-stem bulrush), flow, depth and aspect of constructed wetlands on herbicide and nutrient removal; and (3) design and install a pilot scale, subsurface flow gravel constructed wetlands at a container nursery grower's site for removal of herbicides and nutrients and for demonstration to growers and other interested parties.


Container nursery during irrigation

In the spring and summer of 1998 and 1999, a field study was conducted at the Baxter, Tennessee wastewater treatment plant, where constructed wetland cells have been studied since 1992. A container nursery (450m2) was built on site with overhead irrigation. Water runoff from the container nursery was pumped into fourteen gravel subsurface flow constructed wetland cells. Bulrush, *Scirpus validus*, was grown in seven of the cells, and seven cells had no plants. The wetland cells were either 30 or 45 cm in depth. Three loading rates of runoff water containing herbicides and nutrients were added, corresponding to hydraulic retention times of two to twenty-one days. The removal of herbicides, simazine and metolachlor, and nutrients, nitrogen and phosphorus, in each of the constructed wetland cells was calculated and correlated with bulrush vegetation, loading rates, depth of cell and hydraulic retention time.

Constructed wetland cells with plants removed significantly more simazine, nitrogen and phosphorus than cells without plants. Cells with plants removed more metolachlor at two-eight day retention times, but at higher water retention times there was no difference. Nitrogen removal was greater with cells 45 cm deep (89%) compared to the 30 cm deep cells (76%). Depth did not affect herbicide or phosphorus removal. Removal of simazine ranged from 57 to 96%, and metolachlor removal ranged from 18 to 95% of that applied; no significant difference in removal was seen between the first year and second year of the project. In constructed wetland cells with plants, approximately 60-65% of herbicides were removed at the high loading rate, which was equivalent to a two or three-day hydraulic retention time. Increasing the retention time to eight or more days improved herbicide removals to above 80% in the cells with plants. Nitrogen removal was greater than 90% with all vegetated cells. Phosphate removal was greater than 85% for all vegetated cells except one cell, which had the shortest retention time.





A newly constructed wetland may require some time for plants to become established and this may affect removal efficiencies. The system at Baxter was a mature system with wetland bulrush plants established since 1992, and plant densities greater than 300 stems per m2. A pilot, subsurface flow gravel constructed wetland has been installed at a nursery

in Smithville, Tennessee and is being evaluated for operation, maintenance and removal efficiencies. A demonstration of this wetland is planned for the Fall of 2000.

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